



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

~~REF ID: A6A~~
DEC 30 1968

MSFN Internal Note No. 68-FM-311

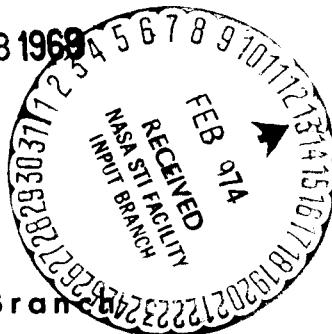
MSC INTERNAL NOTE NO. 68-FM-311

December 19, 1968

MSFN NAVIGATION ERROR ANALYSES
FOR THE APOLLO 8 MISSION

Technical Library, Bellcomm, Inc.

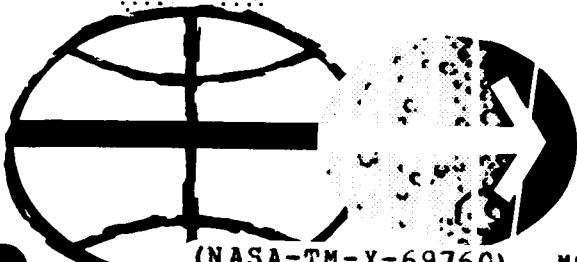
AUG 13 1969



Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



(NASA-TM-X-69760) MSFN NAVIGATION ERROR
ANALYSES FOR THE APOLLO 8 MISSION (NASA)
11 p

N74-70905

00/99 Unclassified
16429

MSC INTERNAL NOTE NO. 68-FM-311

PROJECT APOLLO

MSFN NAVIGATION ERROR ANALYSES FOR
THE APOLLO 8 MISSION

By Navigation Analysis Section
Mathematical Physics Branch

December 19, 1968

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved:


James C. McPherson, Chief
Mathematical Physics Branch

Approved:


John P. Mayer, Chief
Mission Planning and Analysis Division

FOREWORD

This document summarizes the expected RTCC navigation capabilities during cislunar operations of the Apollo 8 mission. These capabilities were analyzed both with and without spacecraft venting.

The results of these MSFN navigation error analyses indicate that navigation using the MSFN tracking data will provide excellent support for cislunar operations if there are no venting perturbations to the orbit. The pericynthion prediction capability is ± 5 n. mi. at TLI-plus-20-hours (fig. 3), and the horizontal in-plane velocity accuracy is ± 1 fps at TEI-plus-18-hours (fig. 6).

For a continuous vent of 0.01 lb (3σ) directed along the velocity vector, the RTCC cislunar navigation support capability degrades to an unacceptable level. The pericynthion prediction accuracy degrades to ± 19 n. mi. at TLI-plus-47-hours (fig. 3). The horizontal in-plane velocity uncertainty is greater than the ΔV required to change the entry flight-path angle 1.0° for most of the transearth coast (fig. 6). These results demonstrate the need to prevent venting if possible. However, in the event venting cannot be avoided, the effect of these perturbations on the orbit determination capability can be practically nullified by reversing the direction of the spacecraft X-body axis every 3 hours.

Figures 1, 2, 4, and 5 illustrate the expected degradation to the local RTCC orbit determination solutions with a venting thrust of 0.01 lb directed along the velocity vector. The RTCC orbit determination program has no mathematical model for spacecraft venting. Therefore, the analyses in this document considered this thrust to be a systematic error source.

The trajectory used for these analyses was the 72.1° launch azimuth for December 21, 1968, contained in reference 1. While the cislunar coast time will vary throughout the launch window, these results are typical of the RTCC orbit determination accuracies expected for launches in the December 1968 and January 1969 launch windows. The error model assumptions for these studies are consistent with reference 2.

FIGURES

Figure		Page
1	Apollo 8 translunar local MSFN position accuracies	1
2	Apollo 8 translunar local MSFN velocity accuracies	2
3	Apollo 8 translunar pericynthion altitude predicted accuracies	3
4	Apollo 8 transearth local MSFN position accuracies	4
5	Apollo 8 transearth local MSFN velocity accuracies	5
6	Apollo 8 transearth MSFN tracking accuracies and entry corridor control requirements	6

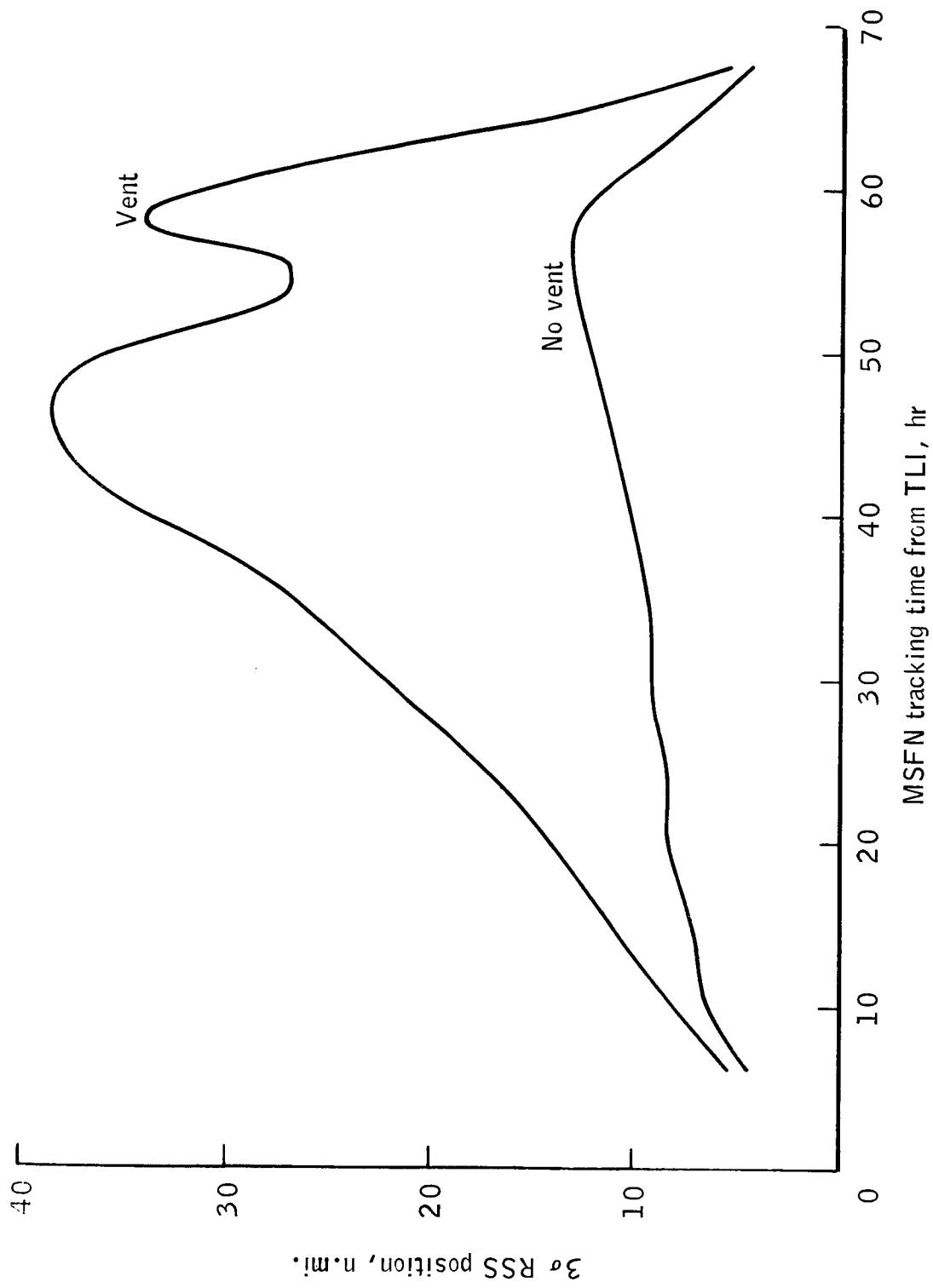


Figure 1.- Apollo 8 translunar local MSFN position accuracies.

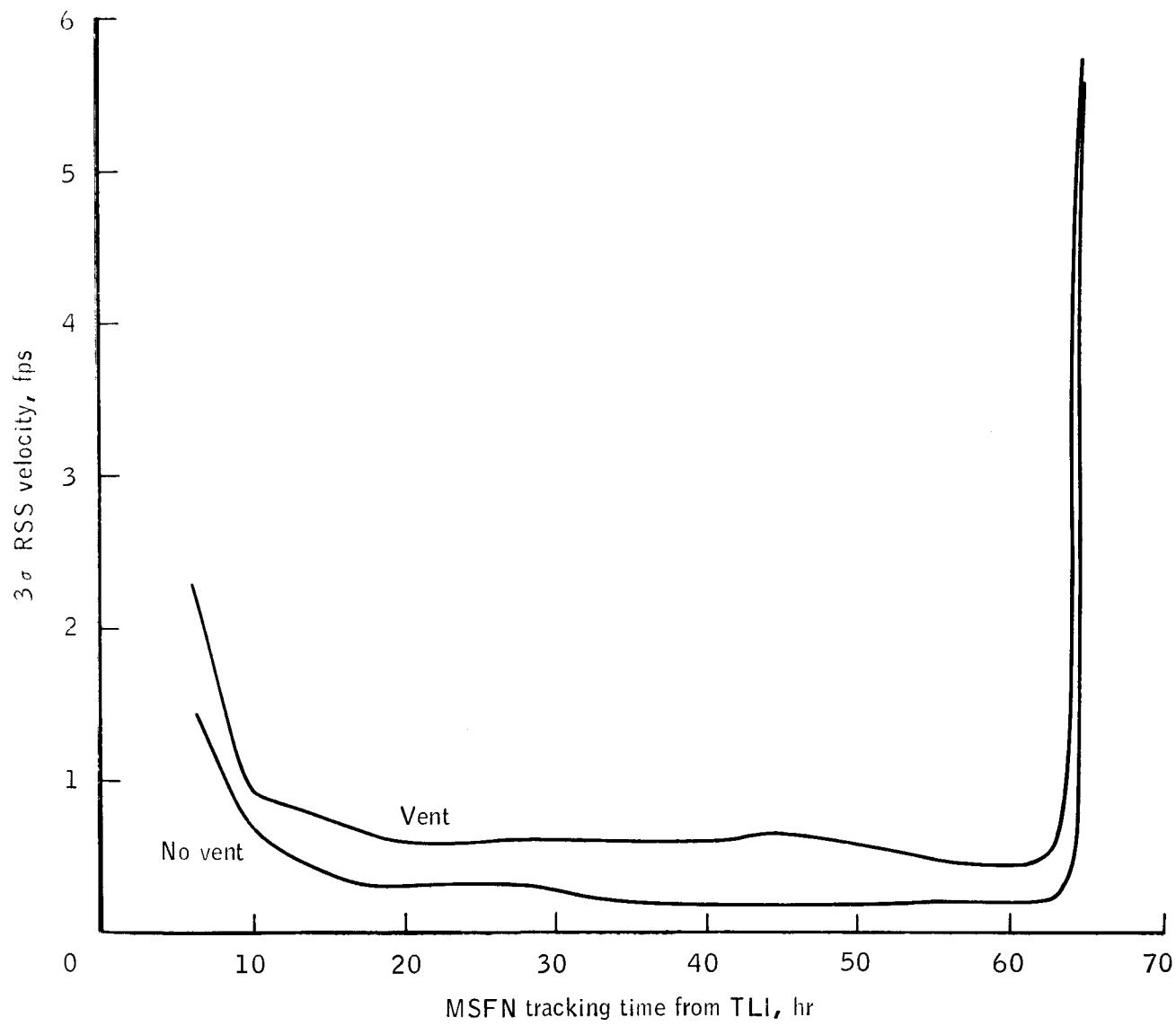


Figure 2.- Apollo 8 translunar local MSFN velocity accuracies.

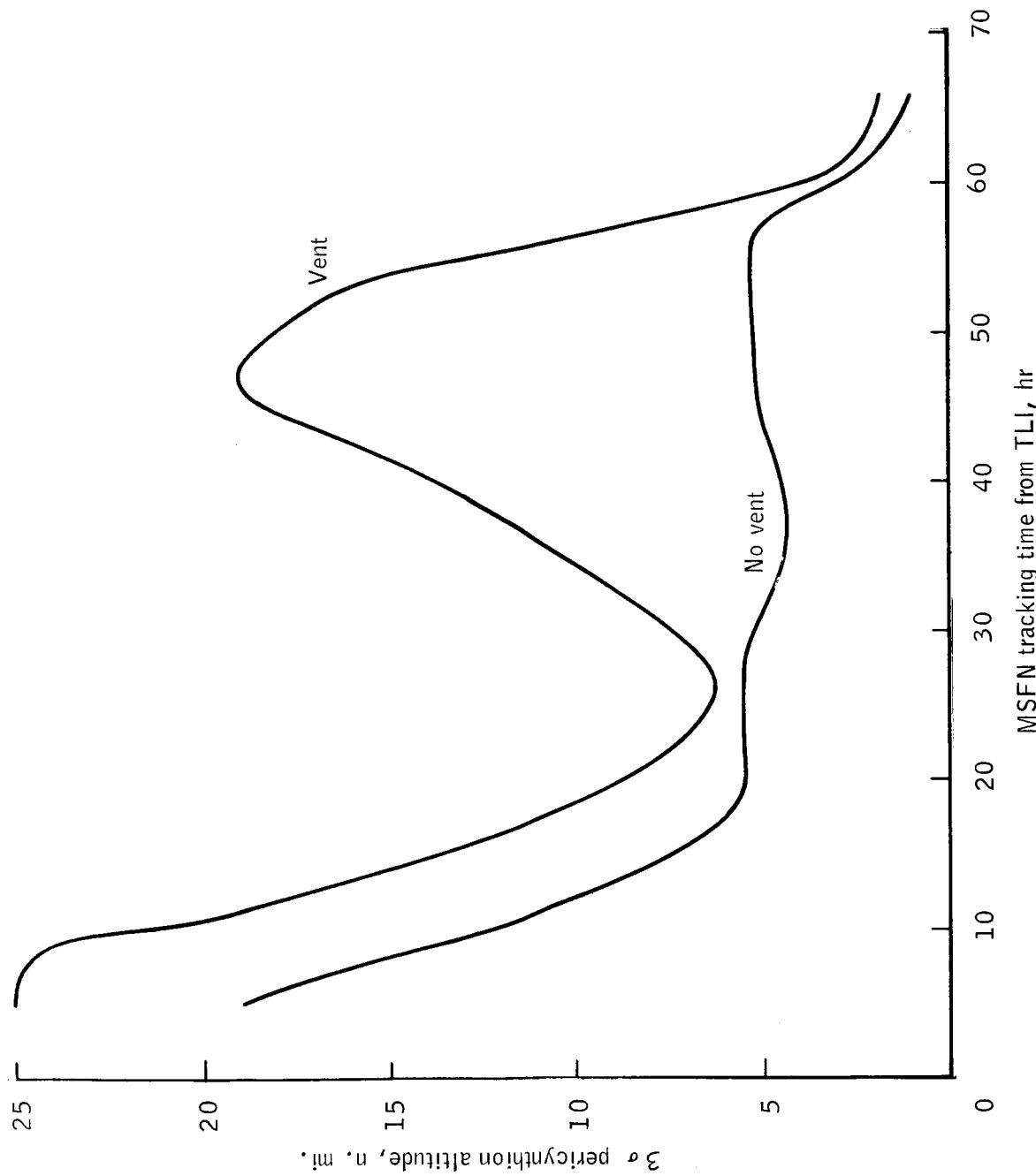


Figure 3.-Apollo 8 translunar pericynthion altitude predicted accuracies.

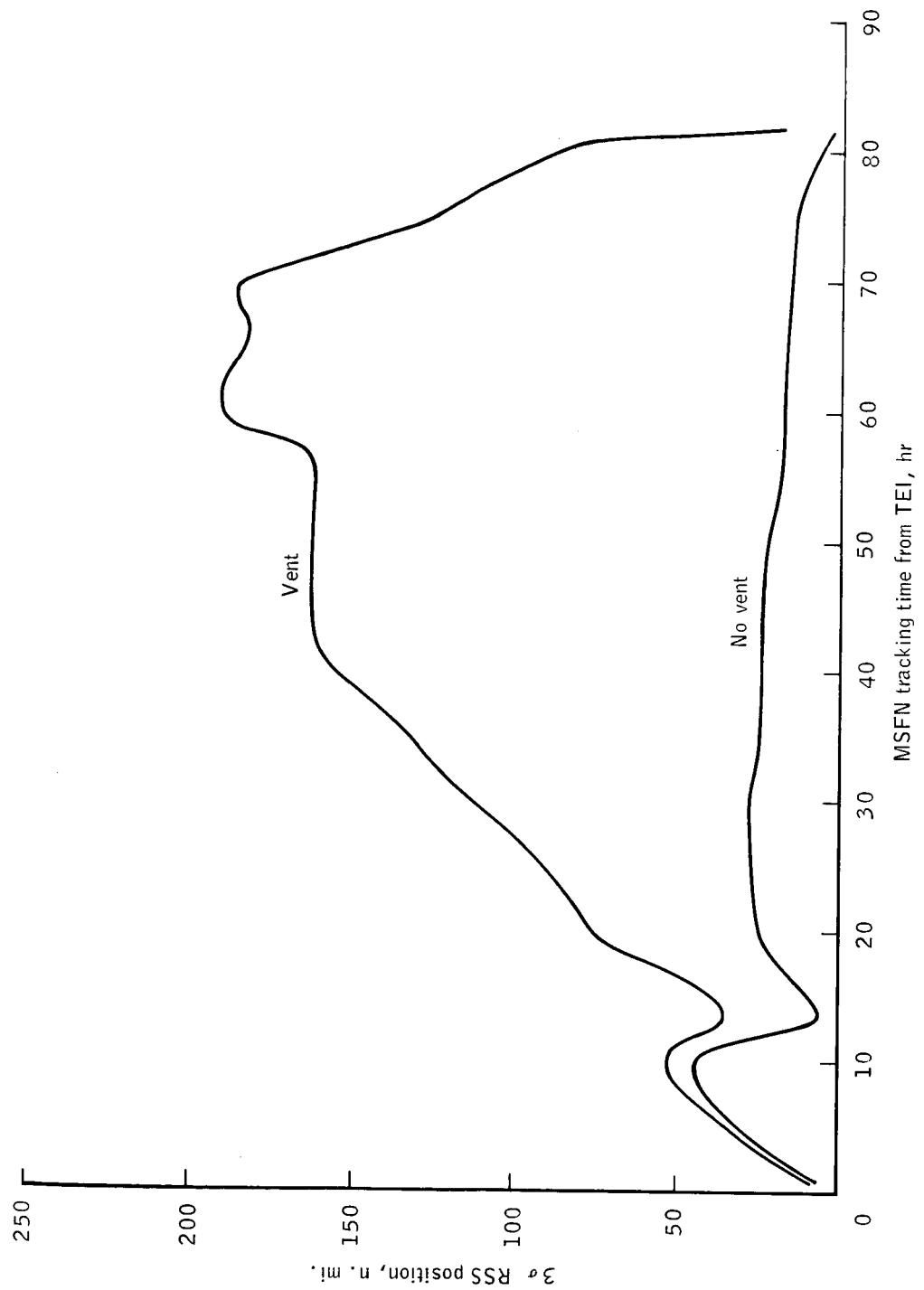
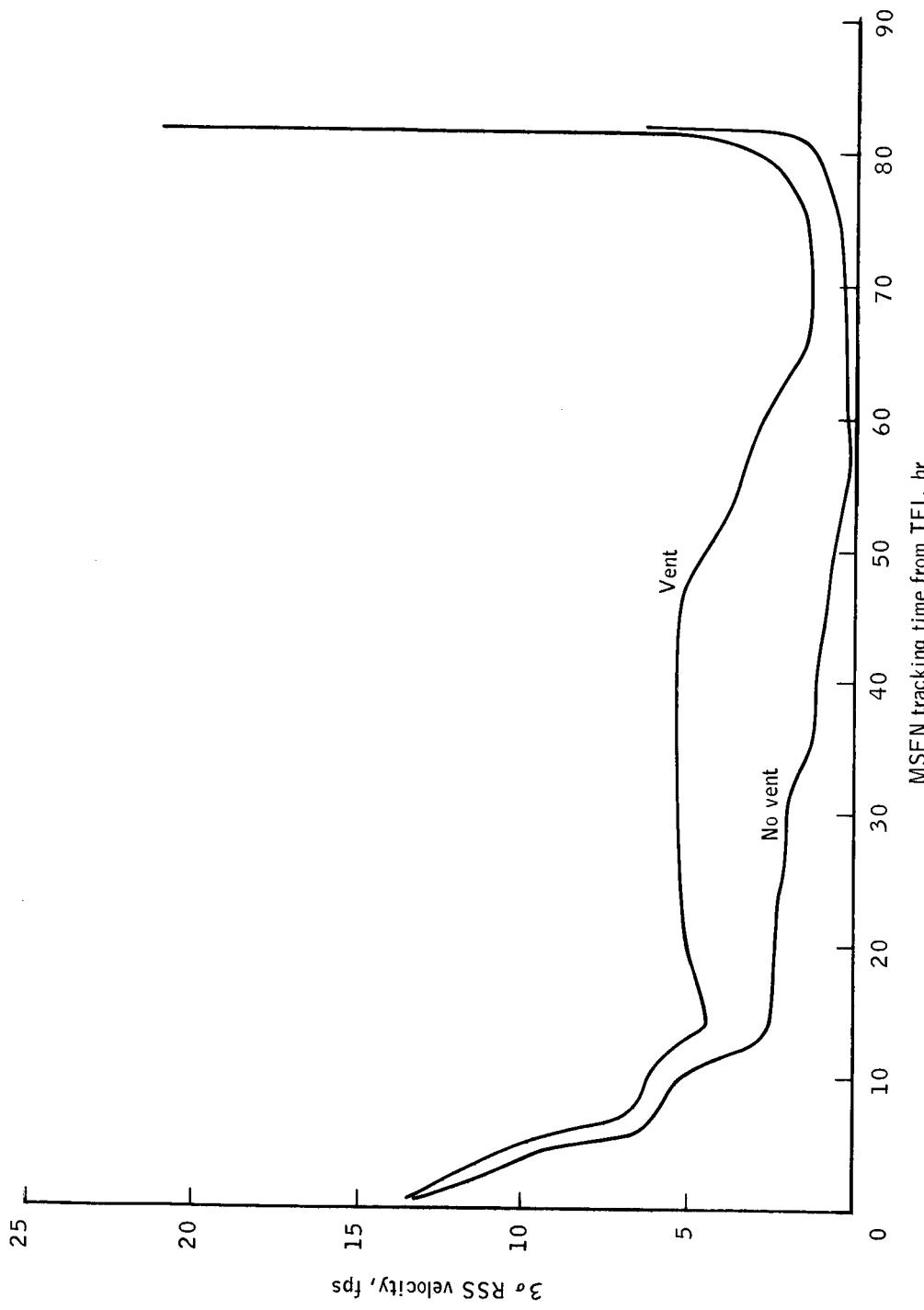


Figure 4.- Apollo 8 transearth local MSFN position accuracies.

Figure 5. - Apollo 8 transearth local MSFN velocity accuracies.



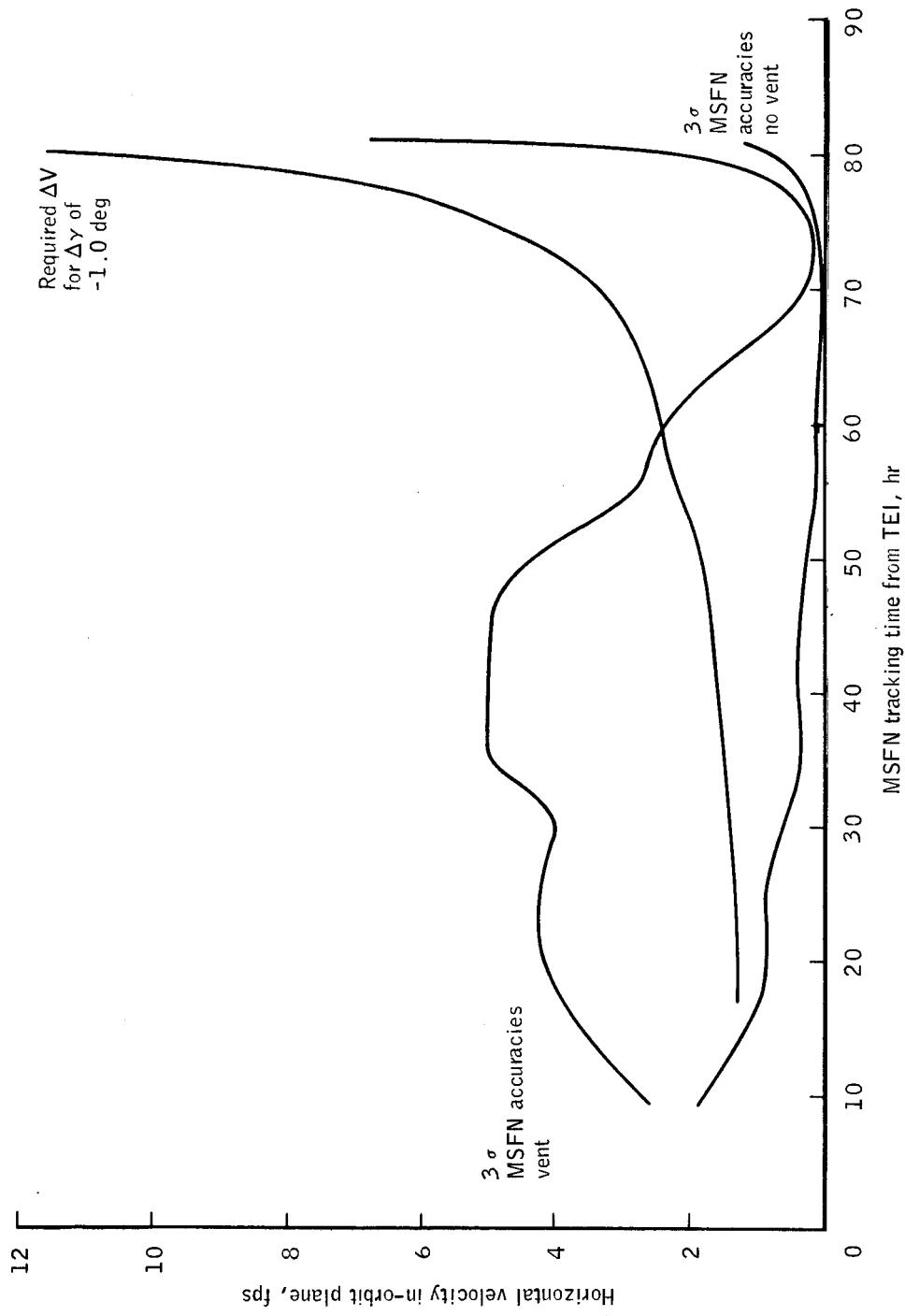


Figure 6.- Apollo 8 transearth MSFN tracking accuracies and entry corridor control requirements.

REFERENCES

1. LMAB: Apollo Mission C' Spacecraft Operational Trajectory Alternate 1, Lunar Orbital Mission, Volume II - Trajectory Parameters for a Mission Launched December 21, 1968. MSC IN 68-FM-253, October 8, 1968.
2. ANWG: Apollo Missions and Navigation Systems Characteristics. Apollo Navigation Working Group Technical Report no. 66, AN1.3, December 15, 1967.